

## Message Text

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SUBJECT: AIR POLLUTION EXHIBITION/SEMINAR UNDER US/USSR  
ENVIRONMENTAL AGREEMENT

REFERENCE: MOSCOW 1184, 1333

BROWN-DARBYSHIRE TELECON 29 JANUARY

FOLLOWING IS TEXT OF MORGAN PRESENTATION:

TITLE: SYSTEMS OF MEASUREMENT EMPLOYED IN THE UNITED  
STATES FOR DEMONSTRATION OF AIR QUALITY

I. INTRODUCTION

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APPROXIMATELY 250 DIFFERENT REGIONS WERE RECENTLY  
IDENTIFIED IN THE UNITED STATES WHERE AIR POLLUTION MUST  
BE CONTROLLED WITHIN THE IMMEDIATE FUTURE. FURTHERMORE,  
NATIONAL ATMOSPHERIC STANDARDS HAVE BEEN ESTABLISHED, BY

MEANS OF FEDERAL LEGISLATION, FOR PARTICULATE MATTER, SULFUR OXIDES, CARBON MONOXIDE, NITROGEN OXIDES, PHOTOCHEMICAL OXIDANTS, AND HYDROCARBONS.

THE CLEAN AIR ACT, AMENDED IN 1970, STIPULATED THAT THE VARIOUS STATES MUST PRESENT TO THE ADMINISTRATOR OF THE ENVIRONMENTAL PROTECTION AGENCY A PLAN FOR CONTROLLING AIR

POLLUTION IN THEIR RESPECTIVE REGIONS. THIS PLAN, CALLED THE "IMPLEMENTATION PLAN" MUST DESCRIBE, AMONG OTHER THINGS (INCLUDING CONTROL METHODS AND THE STRATEGY TO BE USED IN THIS CONTROL), THE MANNER IN WHICH THE STATE AGENCIES WILL DEVELOP THEIR SYSTEM TO MEASURE AIR POLLUTION. FEDERAL LEGISLATION DICTATES THE AMOUNT AND TYPE OF INSTRUMENTS OR MECHANIZED APPARATUS THAT MUST BE USED FOR THESE MEASUREMENTS. FURTHER, THE LEGISLATION, BASED ON EXPERIENCE GATHERED DURING THE OPERATION OF MEASUREMENT SYSTEMS PREVIOUSLY CARRIED OUT BY THE ENVIRONMENTAL PROTECTION AGENCY, DESCRIBES THE FREQUENCY WITH WHICH THE MEASUREMENTS MUST BE PERFORMED. THIS OUTLINE WILL CONSIST OF PRESENTING SOME OF THIS LEGISLATION AND DESCRIBING THE SYSTEM AND METHODS THAT ARE PRESENTLY THE MOST USEFUL FOR THESE CASES.

## II. OBJECTIVES OF A CONTROL SYSTEM AIMED AT ENVIRONMENTAL POLLUTION

A SYSTEM OF MEASUREMENT MUST:

A. PERMIT THE EVALUATION OF PROGRESS TOWARDS THE ACHIEVEMENT OF FEDERAL STANDARDS.

B. PERMIT THE ACTIVATION OF PROCESSES FOR PREVENTING SITUATIONS WHICH, DUE TO SPECIAL METEOROLOGICAL CONDITIONS, CAUSE THE PRESENCE OF POLLUTANTS IN HIGH CONCENTRATIONS.

THE FIRST OBJECTIVE SUGGESTS THE USE OF APPARATUS OR SYSTEMS IN WHICH THE FINAL DATA CAN BE CALCULATED IN A UNCLASSIFIED

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LABORATORY AT ANY MOMENT AFTER THE GATHERING OF SAMPLES.

ON THE CONTRARY, DATA DESCRIBING THE STATE OF THE ENVIRONMENT DURING CONDITIONS WHERE POLLUTION EXISTS IN HIGH DEGREES, ARE REQUIRED INSTANTANEOUSLY, IF POSSIBLE. ONLY IN THIS MANNER CAN THERE BE IMMEDIATE ACTIVATION OF CONTROLS ON THE SOURCES OF INDUSTRIAL EMISSIONS, AND, AT THE SAME TIME, THE RAPID REDUCTION OF CONCENTRATIONS OF THE VARIOUS POLLUTANTS THAT ARE FOUND IN THE AIR.

FOR THESE REASONS, THE SYSTEM AND METHODS SUGGESTED IN LEGISLATIONS, AND DETAILED HERE, CONTAIN REQUIREMENTS FOR INSTANTANEOUS AS WELL AS DELAYED MEASUREMENTS.

### III. SYSTEMS OF MEASUREMENTS

#### A. PARTICULES

THE VARIOUS APPROACHES TO PARTICULATE MEASUREMENT INCLUDE: HIGH-VOLUME AND LOW-VOLUME FILTRATION SAMPLING,

MEASUREMENT OF INDIVIDUAL PARTICLE DENSITY AND OPTICAL CHARACTERISTICS, MEASUREMENTS OF AEROSOL OPACITY AND LIGHT SCATTER, AND SETTLING RATES. MEASUREMENTS OF THE ALLERGENICITY AND INFECTIVITY OF AEROSOLS ARE ALSO FREQUENTLY MADE. HOWEVER, THIS PRESENTATION WILL BE LIMITED TO THOSE DEVICES IN GENERAL USE AND CONSIDERED TO BE CONTINUOUS MONITORS.

#### SUSPENDED PARTICULATES

THE RECOMMENDED INSTRUMENT FOR SAMPLING LARGE VOLUMES OF AIR FOR SUSPENDED PARTICULATE MATTER IS THE HIGH-VOLUME SAMPLER. THIS SAMPLER CONSIST OF A SPECIALLY HOUSED VACUUM MOTOR TO WHICH IS ATTACHED A FILTER HOLDER OR ADAPTER. IT IS EVALUATED AND DESCRIBED BY ROBSON AND FOATER. WHILE THIS DEVICE IS NOT TRULY A CONTINUOUS-AUTOMATIC INSTRUMENT, IT IS AT PRESENT THE ONLY DEVICE THAT HAS RECEIVED WIDE ACCEPTANCE IN THE UNITED STATES FOR THE DETERMINATION OF TOTAL SUSPENDED PARTICULATES BETWEEN 0.3 AND 100 MICRONS IN SIZE.

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THE ADAPTER MAY BE OF ONE OF TWO TYPES: A CIRCULAR 4 INCH-DIAMETER FILTER HOLDER OR A LARGER 8 BY 10 INCH RECTANGULAR ADAPTER. THE FORMER IS NORMALLY USED IN INDUSTRIAL-HYGIENE STUDIES AND WILL NOT BE CONSIDERED IN THIS REPORT. THE LATTER ADAPTER CONSISTS OF TWO PARTS: THE CONE-SHAPED STAINLESS STEEL FILTER-SUPPORT SCREEN AND AN OPEN RECTANGULAR FACE PLATE OF CASE IRON WITH A SPONGE-RUBBER GASKET. IN SAMPLING, A FILTER IS PLACED BETWEEN THE FILTER-SUPPORT SCREEN AND THE GASKET FACE PLATE. WHEN THE ADAPTER IS SCREWED ONTO THE BLOWER UNIT, A CIRCULAR RUBBER GASKET IS USED TO MAKE AN AIRTIGHT SEAL.

AIR DRAWN THROUGH THE FILTER IS MEASURED WITH A "VISA-FLOAT" FLOWMETER WHICH MUST BE CALIBRATED. SAMPLES ARE USUALLY COLLECTED FOR ABOUT 24 HOURS, WITH A FLOWMETER READING AT THE BEGINNING AND END OF EACH SAMPLING PERIOD. THE AVERAGE RATE OF FLOW IS THEN DETERMINED FROM A CALIBRATION CHART FOR EACH INSTRUMENT. IF DESIRED, THIS DEVICE MAY BE MODIFIED FOR CONTINUOUS FLOW MEASUREMENT AND RECORDING.

THE MODIFICATION CONSISTS OF AN ORIFICE METER ASSEMBLY ATTACHED TO THE EXHAUST END OF A HIGH-VOLUME BLOWER UNIT. A BELLOWS-TYPE PRESSURE TRANSDUCER IS CONNECTED TO THE DIFFERENTIAL PRESSURE TAP OF THE ORIFICE METER. THE PRESSURE DEVELOPED ACROSS THE ORIFICE IS CONTINUOUSLY RECORDED ON A CIRCULAR CHART AND IS CONVERTED TO CORRECTED

AIRFLOW BY MEANS OF APPROPRIATE CALCULATIONS.

THE FILTER MATERIAL IS GENERALLY GLASS FIBER, ALTHOUGH INERT PLASTIC MATERIALS ARE USED IN SPECIAL SAMPLINGS FOR CERTAIN METALLIC COMPOUNDS. THE FILTER WITH THE COLLECTED PARTICULATE IS ROUTINELY SENT TO THE LABORATORY FOR NOT ONLY THE DETERMINATION OF THE TOTAL PARTICULATE LOADING, BUT FOR SUBSEQUENT ANALYSIS BY EMISSION SPECTROSCOPY FOR THE FOLLOWING METALS: GR, GU, FE, PB, MN, MI, SN, TI, ZN, SB, BI, CD, CO, MO, Y. IN ADDITION, ANALYSIS FOR SULFATES, NITRATES, AND UNCLASSIFIED

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POLYNUCLEAR HYDROCARBONS MAY BE PERFORMED.

TRACE METALS MAY BE ANALYZED BY EITHER THE ATOMIC ABSORPTION SPECTROMETER OR THE EMISSION SPECTROGRAPH. SAMPLE PREPARATION FOR BOTH METHODS INVOLVES THE SAME ACID EXTRACTION OF THE COLLECTED MATERIAL TO DISSOLVE THE METALS. BOTH METHODS ARE SPECIFIC FOR A GIVEN METAL BECAUSE IT MEASURES THE AMOUNT OF LIGHT EMITTED OR ABSORBED AT A WAVELENGTH THAT IS SPECIFIC FOR THE METAL. THE ATOMIC ABSORPTION METHOD DETERMINES ONE METAL PER ANALYSIS WHEREAS THE EMISSION SPECTROGRAPH DETERMINES 15 TO 30 METALS PER ANALYSIS. REGARDLESS, THE TWO METHODS ARE COMPLEMENTARY BECAUSE THE EMISSION SPECTROGRAPH IS MUCH MORE SENSITIVE FOR METALS SUCH AS COBALT, NICKEL, HAFNIUM, VANADIUM, AND BISMUTH AND THE ATOMIC ABSORPTION IS MORE SENSITIVE FOR ARSENIC, BARIUM, CADMIUM, CHROMIUM, COPPER, MANGANESE, LEAD, THALLIUM, AND ZINC.

#### B. SULFUR DIOXIDE

THE MEASUREMENT OF THIS IS PERFORMED BY MEANS OF AN APPARATUS CONSISTING OF A SERIES OF TUBES CONTAINING SPECIFIC SOLUTIONS FOR EACH POLLUTANT. A SUCTION PUMP BRINGS THE AIR SAMPLE THROUGH THE SOLUTION AND IN THIS MANNER THE POLLUTANT CONTAINED THEREIN IS ABSORBED. THE SOLUTION EMPLOYED FOR THIS ANALYSIS IS PARA-ROSANILINE. WE RECOMMEND THE TAKING OF SAMPLES WITH 24-HOUR DURATION, EVERY SIX DAYS.

ASIDE FROM THE ABOVE MENTIONED METHOD, WE RECOMMEND THE USE OF INSTRUMENTS PERMITTING CONTINUOUS MEASUREMENT

OF SULFUR DIOXIDE. AT PRESENT, THERE ARE MANY MANUFACTURING COMPANIES IN THE UNITED STATES THAT MAKE INSTRUMENTS FOR THIS APPLICATION. THE LEGISLATION WHICH REFERS TO THIS MEASUREMENT SUGGESTS INSTRUMENTATION THAT USES COULOMETRIC, COLORIMETRIC, CHROMATOGRAPHIC AND FLAME PHOTOMETRIC BASES.

#### C. PHOTOCHEMICAL OXIDANTS

THE ACCURACY OF NEUTRAL BUFFERED POTASSIUM IODIDE  
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(NBKI) TECHNIQUES USED IN CALIBRATION PROCEDURES FOR ATMOSPHERIC OZONE (O<sub>3</sub>) MONITORS HAS BEEN THE SUBJECT OF CONSIDERABLE CONTROVERSY. IN THIS STUDY MEASUREMENTS OBTAINED BY NBKI SOLUTION WERE SIMULTANEOUSLY COMPARED WITH O<sub>3</sub> MEASUREMENTS BY ULTRAVIOLET ABSORPTION (UV) AND BY GAS PHASE TITRATION (GPT) EMPLOYING A STANDARD CYLINDER OF NITRIC OXIDE (NO) IN NITROGEN. THE O<sub>3</sub> CONCENTRATION RANGE COVERED WAS 0.05 TO 10 PPM. AGREEMENT WAS OBTAINED TO WITHIN LESS THAN TWO PERCENT BETWEEN UV AND GPT O<sub>3</sub> MEASUREMENTS OVER THE CONCENTRATION RANGE, 0.05 TO 0.8 PPM. THE RELATION BETWEEN O<sub>3</sub> MEASURED BY NBKI AND BY UV WAS LINEAR OVER THE RANGE 0.05 TO 10 PPM. AT HIGHER O<sub>3</sub> CONCENTRATIONS THE IODOMETRIC MEASUREMENTS APPROACHED VALUES 11 PERCENT HIGHER THAN UV MEASUREMENTS.

#### D. CARBON MONOXIDE

FOR THIS POLLUTANT, WE RECOMMEND THE USE OF CONTINUOUS MEASUREMENT INSTRUMENT HAVING A NON-DISPERSIVE INFRARED BASE. THIS METHOD IS BASED ON THE ABSORPTION OF INFRARED RADIATION BY CARBON MONOXIDE. ENERGY FROM A SOURCE EMITTING RADIATION IN THE INFRARED REGION IS SPLIT INTO PARALLEL BEAMS AND DIRECTED THROUGH REFERENCE AND SAMPLE CELLS. BOTH BEAMS PASS INTO MATCHED CELLS, EACH CONTAINING A SELECTIVE DETECTOR AND CO. THE CO IN THE CELLS ABSORB INFRARED RADIATION ONLY AT ITS CHARACTERISTIC FREQUENCIES AND THE DETECTOR IS SENSITIVE TO THOSE FREQUENCIES. WITH A NON-ABSORBING GAS IN THE REFERENCE CELL, AND WITH NO CO IN THE SAMPLE CELL, THE SIGNALS FROM BOTH DETECTORS ARE BALANCED ELECTRONICALLY. ANY CO INTRODUCED INTO THE SAMPLE CELL WILL ABSORB RADIATION, WHICH REDUCES THE TEMPERATURE AND PRESSURE IN THE DETECTOR CELL AND DISPLACES A DIAPHRAGM. THIS DISPLACEMENT IS DETECTED ELECTRONICALLY AND AMPLIFIED TO PROVIDE AN OUTPUT SIGNAL. THIS METHOD IS APPLICABLE TO THE DETERMINATION OF CARBON MONOXIDE IN AMBIENT AIR, AND TO THE ANALYSIS OF GASES UNDER PRESSURE.

IN ADDITION TO THE ABOVE METHOD, THERE ARE SEVERAL EXCELLENT GAS CHROMATOGRAPHIC METHODS FOR MEASURING CARBON MONOXIDE WHICH ARE ACCURATE AND DEPENDABLE.

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E. NITROGEN DIOXIDE

THE COLORIMETRIC METHOD IS THE MANUAL PROCEDURE  
RECOMMENDED FOR THIS POLLUTANT. WHEN AIR CONTAINING

NITROGEN DIOXIDE IS DRAWN THROUGH A SODIUM HYDROXIDE-  
SODIUM ARSENITE SOLUTION, A DILUTE SOLUTION OF SODIUM  
NITRITE IS PRODUCED. THIS COLLECTING SOLUTION IS  
REACTED WITH SOLUTIONS CONTAINING PHOSPHORIC ACID,  
SULFANILAMIDE, AND N-(1-NAPHTHYL)-ETHYLENEDIAMINE  
DIHYDROCHLORIDE AND AN AZO DYE IS PRODUCED. THE AMOUNT  
OF AZO DYE PRODUCED IS PROPORTIONAL TO THE NITROGEN  
DIOXIDE CONCENTRATION. THE RESULTING AZO DYE IS MEASURED  
COLORIMETRICALLY AND THE CONCENTRATION OBTAINED FROM  
THESE MEASUREMENTS.

THE REVERSE CHEMILUMINESCENCE PROCEDURE SIMILAR TO  
THAT EMPLOYED FOR THE MEASUREMENT OF PHOTOCHEMICAL  
OXIDANT (OZONE) DESCRIBED ABOVE, IS THE SYSTEM FOR  
CONTINUOUS MEASUREMENT OF NITROGEN DIOXIDE. SEVERAL  
MODIFICATIONS OF THIS METHOD WILL BE DISCUSSED BY THE  
INSTRUMENT MANUFACTURERS.

IV. THE PLACEMENT OF APPARATUS AND INSTRUMENTS

LEGISLATION DICTATES THAT THE APPARATUS EMPLOYED FOR  
OBTAINING SAMPLES BE PLACED, AS A MINIMUM, IN:

- A. THE CENTER OF THE POPULATION,
- B. A PLACE OF EXPECTED MAXIMUM POLLUTION,
- C. A SITE IN THE CENTER OF SOURCES OF INDUSTRIAL  
EMISSIONS,
- D. A LOCALITY WHERE FUTURE GROWTH IS ANTICIPATED. KISSINGER

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